UTC Hilton Data Integrator Notes

The UTC Hilton Combined Heat and Power (CHP) system consists of a 200 kW fuel cell that operates on natural gas. Heat will be recovered from the operation of the fuel cell via a glycol loop and plate frame heat exchanger and used to heat domestic hot water loads at the hotel. CHP data at this site is collected and managed by CDH Energy Corp.

Data Point Details

The data at this site is collected by an Obvius AquiSuite A8812 data logger. The data is collected on a 15-minute interval and then made into hourly data for the online database. The data is summed, averaged or the maximum value is taken over the four 15-minute records constituting a single hourly record.

DG/CHP Generator Output (total kWh)
Data for this point comes from Veris power transducer installed on the lower half of the disconnect located on the fuel cell unit itself. The 15-minute data from the fuel cell is summed into hourly data for the online database.

DG/CHP Generator Output Demand (peak kW)
Data for this point comes from Veris power transducer installed on the lower half of the disconnect located on the fuel cell unit itself. The average, minimum and maximum (peak) demand values are recorded. The 15-minute data from the fuel cell is summed into hourly data for the online database.

DG/CHP Generator Gas Input (total cubic feet)
Data for this point comes from a Roots style gas meter installed on the pressure line leaving the fuel gas booster. The pulses have a value of 10 cuft/ and are uncompensated. The 15-minute data is summed into hourly data for the online database and is calibrated to the monthly utility billing data.

Total Facility Purchased Energy (total kWh) and Demand (peak kW)
There is no data for these points available from the Obvius data.

Other Facility Gas Use (total cubic feet)
There is no data for these points available from the Obvius data.

Total Facility Energy (total kWh) and Demand (peak kW)
There is no data for these points available from the Obvius data.

Useful Heat Recovery (total MBtu/h)
The Useful Heat Recovery is integrated by the Obvius datalogger on a 5-second interval. The heat recovery loop temperatures leaving and entering the fuel cell are integrated along with the flow rate and filtered using the valve statuses for the Dry Cooler and Glycol Heat Recovery (HR). Currently, where there is either a glycol HR or chiller load

the heat recovery is assigned as Useful. The energy data is then summed into hourly data.

Unused Heat Recovery (total MBtu/h)
The Unused Heat Recovery is integrated by the Obvius datalogger on a 5-second interval. The difference in the heat recovery loop temperatures leaving and entering the fuel cell are integrated along with the flow rate and filtered using the valve statuses for the Dry Cooler and Glycol Heat Recovery (HR). Currently, where there is no glycol load the heat recovery is assigned as Unused (passive heat recovery only occurs through the glycol loop). The energy data is then summed into hourly data.

Status/Runtime of DG/CHP Generator (total hrs)
The fuel cell is defined as being fully on for a 15-minute interval if the fuel cell output is greater than 45 kW for the period (the fully-loaded capacity is 200 kW). The status is given a value of 0.083 if the generator output is above 45 kW and the generator output is divided by 45 kW if it is below for fractional runtime. The 15-minute data is then summed into hourly data for the online database.

Ambient Temperature (avg °F)
This point is measured directly by a Watlow thermocouple. The 15-minute data for a given hour is averaged for the online database.

Total CHP Efficiency (%)
The Total CHP Efficiency is calculated from the online hourly database as the sum of the Useful Heat Recovery and the DG/CHP Fuel Cell Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas). Because of the coarse nature of the generator gas data, this channel is best viewed on a daily basis.

Electrical Efficiency (%)
The Electrical Efficiency is calculated from the online hourly database as the DG/CHP Fuel Cell Output, converted from kWh to MBtus, divided by the DG/CHP Generator Gas Input. The gas input is converted to MBtus using the Lower Heating Value (LHV) of the fuel which is 0.930 MBtu/cubic foot (Natural Gas). Because of the coarse nature of the generator gas data, this channel is best viewed on a daily basis.

Data Quality Checks

The Data Quality Checks consist of three levels of verification: does the data exist, does the data pass reasonable range checking and does the data pass relational checks. The methodology for applying the data quality checks begins by creating a contiguous database. This is necessary to maintain compatibility between the many sites on the server. Next, the data received for this site is fit into the database, in this case we are using 15-minute data. For any period where there is data, the data quality level is set to 3

for “Passes Relational Checks”. We then work backwards to identify data that does not meet Relational and/or Range Checking.

The next step is to apply the relational checks. Relational checks attempt to identify data which is uncorroborated by the rest of the data set. For instance, data received indicating a DG/CHP Generator output when the gas use is zero is suspect. For data failing a relational check, the data quality level is set to 2 for “Data Passes Range Checks”.

The last step is evaluating the range checks. The range checks consist of reasonable high and low values based on facility and DG/CHP Generator information. Data that falls outside the defined range for the database value has its data quality level set to 1 for “Data Exists.”

It is necessary to work backwards when applying data quality checks to insure that data gets set to the lowest applicable data quality level. It is possible for data to pass the relational check and fail the range check and such data will be set to a data quality level of 1 for “Data Exists.”

Table 1. Data Quality Definitions

Data Quality Levels	Description	Definition
3	Passes Relational Checking	This data passes Range Checks and Relational Checks. This is the highest quality data in the data set.
2	Passes Range Checks	This data passes the Range Checks but is uncorroborated by Relational Checks with other values.
1	Data Exists	This data does not pass Range Checks. This data is found to be suspect based on the facility and/or CHP equipment sizing.
0	Data Does Not Exist	This data is a placeholder for maintaining a contiguous database only.

Details on the Range and Relational Checks are found below.

Relational Checks

These checks are applied to the 15-minute data before it is converted to hourly data. If any of the 15-minute data points fails the relational check, the data for the entire hour is marked as failed.

Table 2. Relational Checks for UTC Hilton

Evaluated Point	Criteria	Result
FG	WG > 10 and FG <=0	DQ Level for FG set to 2
WG_KW	WG_KW > 5 and WG = 0	DQ Level for WG_KW set to 2

Notes: FG – DG/CHP Fuel Cell Gas Use

WG – DG/CHP Fuel Cell Output
WG_KW – DG/CHP Fuel Cell Generator Demand

Range Checks

These checks are applied to the 15-minute data before it is converted to hourly data. If any of the 15-minute data points fails the range check, the data for the entire hour is marked as failed.

Table 3. Range Checks for UTC Hilton

Data Point	Hourly Data Method	Upper Range Check	Lower Range Check
DG/CHP Fuel Cell Output	Sum	45 kWh	0 kWh
DG/CHP Fuel Cell Output Demand	Maximum	200 kW	0 kW
DG/CHP Fuel Cell Gas Use	Sum	1,900 cubic feet	0 cubic feet
Unused Heat Recovery	Sum	125 MBtu	0 MBtu
Useful Heat Recovery	Sum	125 MBtu	0 MBtu
Status/Runtime of DG/CHP Generator	Sum	0.25 hrs	0 hrs
Ambient Temperature	Average	130°F	-30°F

Notes: Data failing the Range Check has the data quality level set to 1 for “Data Exists”

ASERTTI Protocol Adherence

This data at this adhered fully to the ASERTTI Long-Term Monitoring Protocol. The data was sampled in five-second intervals and averaged or summed into 15-minute intervals as per the protocol. In addition, most of the optional parameters were available at this site.

Monitoring Notes

September 7, 2007

Monitoring equipment installed.

September 17, 2007

Corrected installation problems with the fuel cell power transducer and gas meter. Performed verification and commissioned the monitoring system.